

An Error Model for High-Time Resolution Satellite Precipitation Products

Viviana Maggioni, Robert F. Adler,
Mathew R. P. Sapiano, George J.
Huffman, Yudong Tian



ESSIC/University of Maryland
NASA Goddard Space Flight Center



The rationale

- Satellite precipitation estimates have increased in resolution and quality in the past years, but they are not perfect yet!
- Error estimates are of crucial importance, allowing inferences about the reliability of satellite products and their operational application:
 - hydrological models
 - land data assimilation systems
 - water management policy

18 USA TODAY
A GANNETT COMPANY

NEWS SPORTS LIFE MONEY TECH TRAVEL OPINION 64°

Report: Colorado flooding was 'unprecedented'

COLORADO / KUSA



SPEED OF RECOVERY HINGES ON MONEY

HOMICIDE VICTIM OFFICER DOWN MALL SAFETY

Colorado flood repairs hinge on government funds

Local governments in Colorado expect to get money from the state and federal government to help rebuild from the floods, but the speed of rebuilding may depend on how quickly that money gets here. VPC

Doyle Rice, USA TODAY 10:23 a.m. EDT September 26, 2013

The event was likely a 100-year flood.



(Photo: Cliff Grassmick, AP)

STORY HIGHLIGHTS

- Flooding probably unmatched in at least 35 years

Some of the flooding that ravaged Colorado earlier this month was "unprecedented," according to a preliminary assessment issued by government and university scientists Wednesday.

The report was prepared by the Cooperative Institute for Research in Environmental Sciences (CIRES) in Boulder, Colo. The institute includes scientists from the National Oceanic and Atmospheric Administration, the University of Colorado and Colorado State University.

The Global Flood Monitoring System (GFMS) wasn't able to catch the CO flood. Why?

Because the input satellite rainfall data was $\frac{1}{5}$ of the actual rainfall measured at ground!

U.S. NEWS on NBCNEWS.com

NBC News reporters bring you compelling stories from across the nation. For more US news, follow us on Twitter and Facebook.

About this blog Archives E-mail updates Follow on Twitter Subscribe to RSS 1.8m

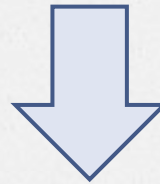
Updated 56 minutes ago

Colorado floods: A month later, mountain towns 'spooky' and deserted



The objective

The goal is to develop a practical method to provide error estimates and test them where high quality comparison data are available.



$$\text{Error } (\varepsilon) = |S - R|$$

Satellite
Observations

Reference/Ground
Observations

The user

The Regular User is more inclined to have the error as one single estimate



Provide a mean (or median) value of the error

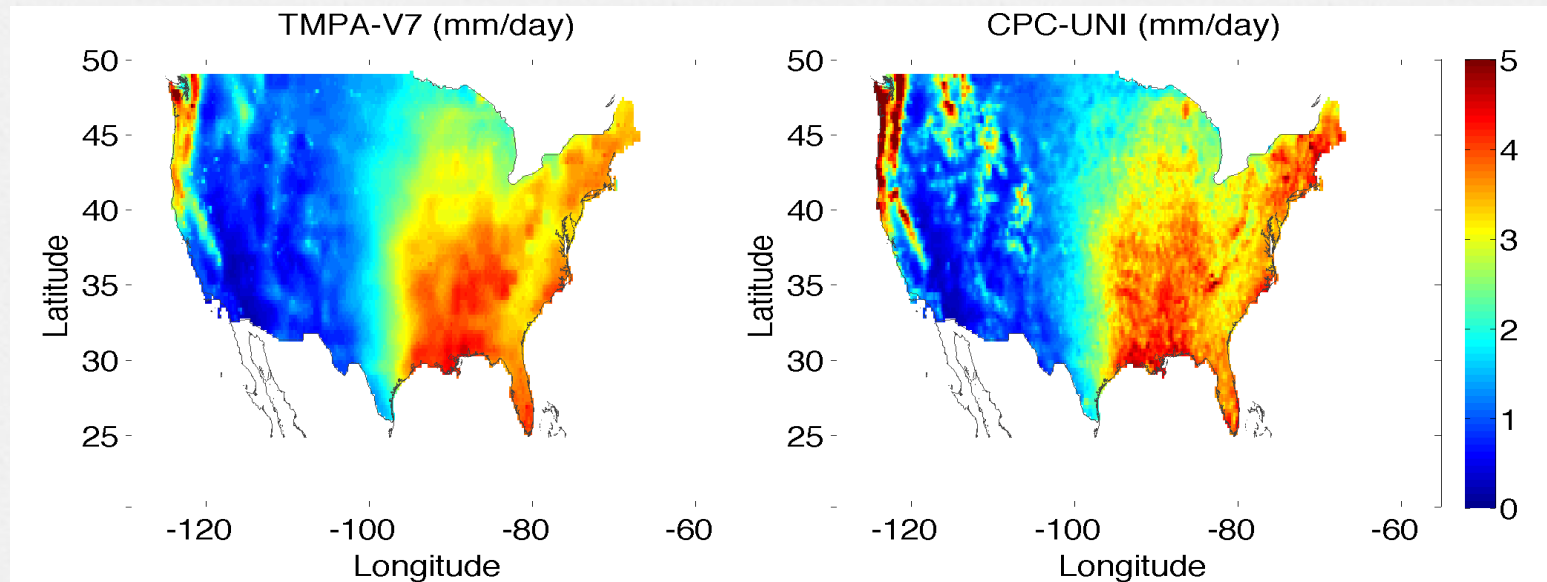


The Expert User is interested in the distribution of the error

Provide representative percentiles (25th, 50th, 95th)

Data sets

- Reference (y): CPC Unified Gauge Analysis
- Satellite (x): TMPA 3B42-V7
- Resolution: 25km/, 1 day
- Time series: 1998-2012



The error components

Reference

$th = 0.1\text{mm/d}$

$y < th$

$y \geq th$

$x < th$

Correct No-Rain Detection
(**85%**)

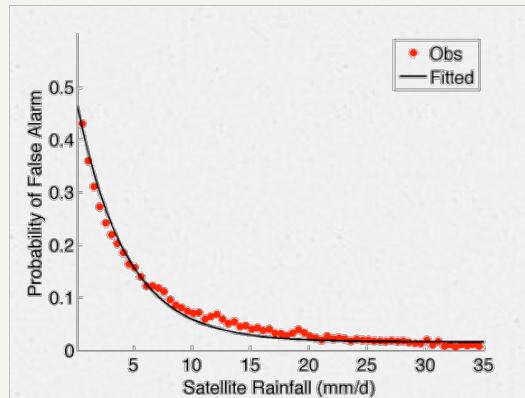
Missed Rain
(**15%**)

\hat{y}_0

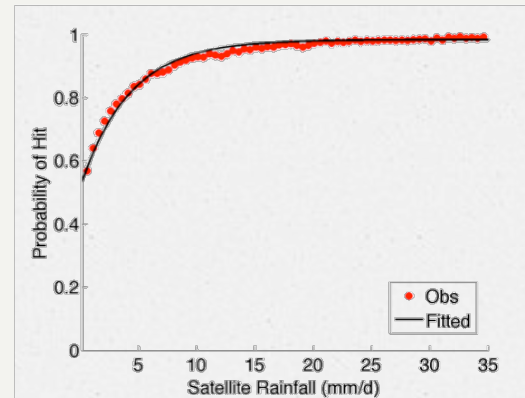
Satellite

$x \geq th$

False Alarm

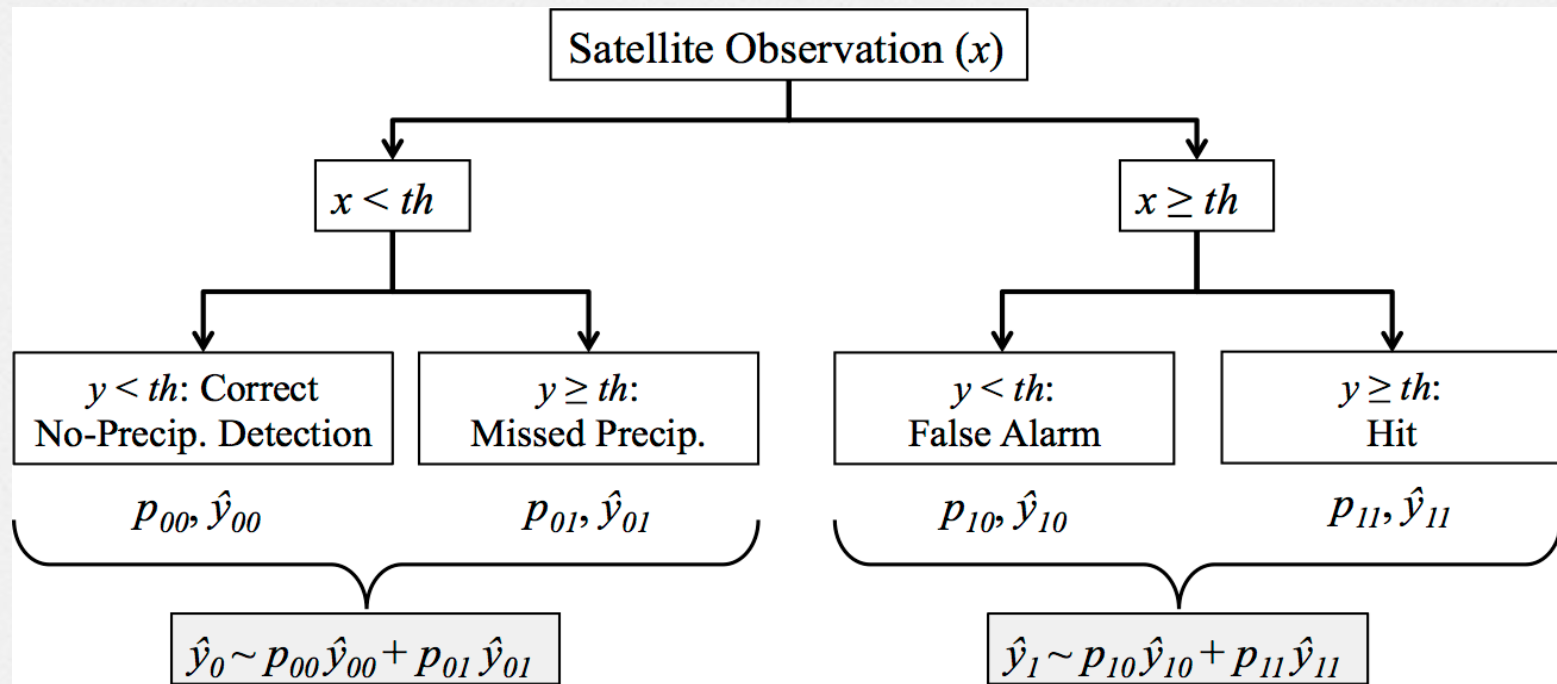


Hit



\hat{y}_1

PUSH: Precipitation Uncertainty for Satellite Hydrology



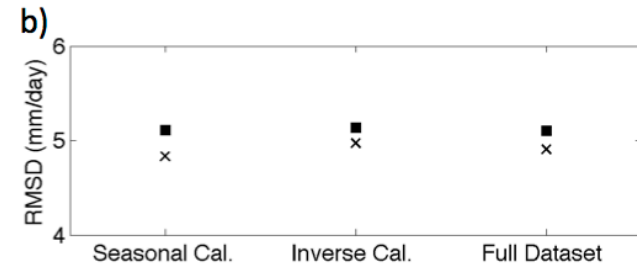
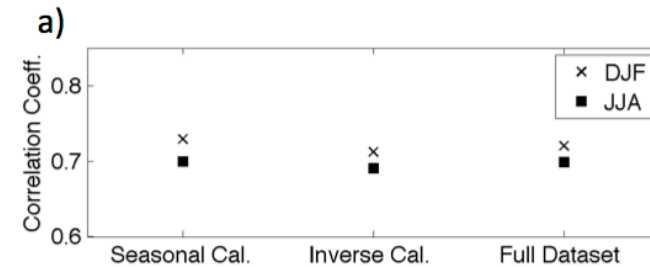
Model output: probability distributions of estimated rainfall (\hat{y})

Calibration over OK

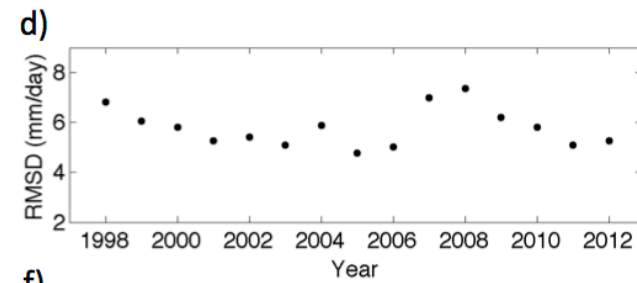
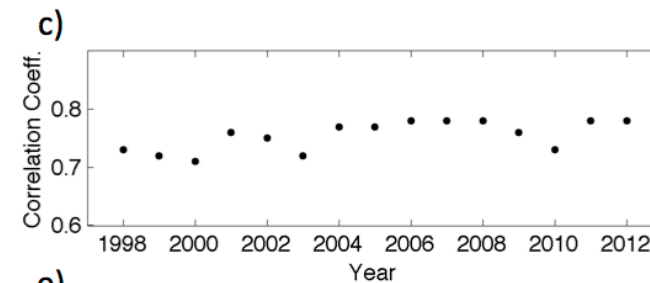
Correlation Coefficient

RMSD

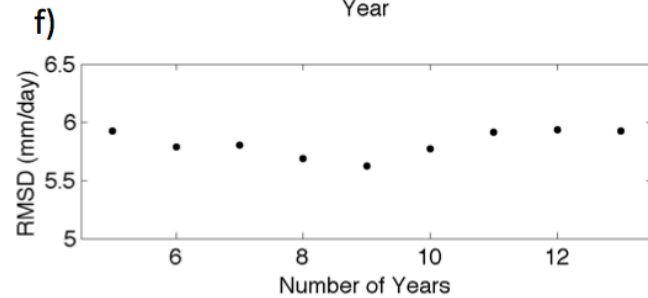
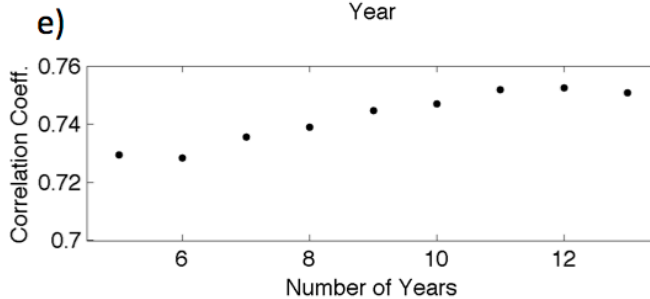
Dependence
on Season



Cross -
Validation

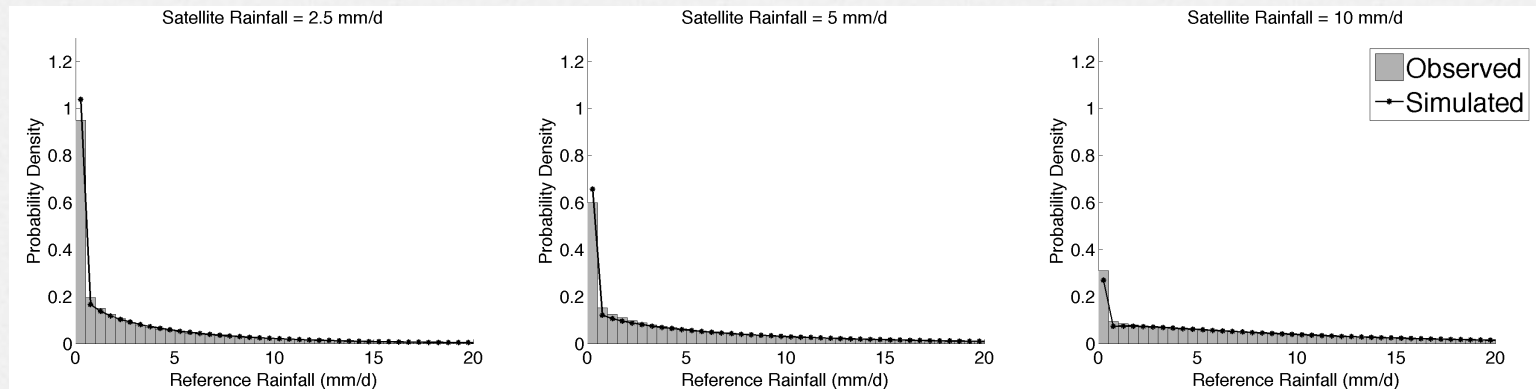


Number of
years

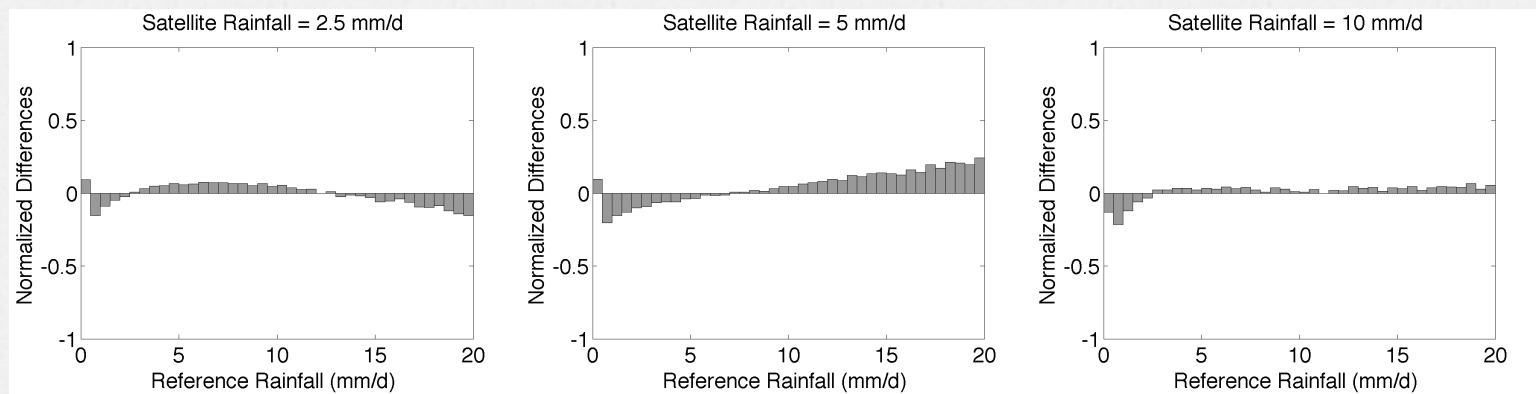


Results over CONUS

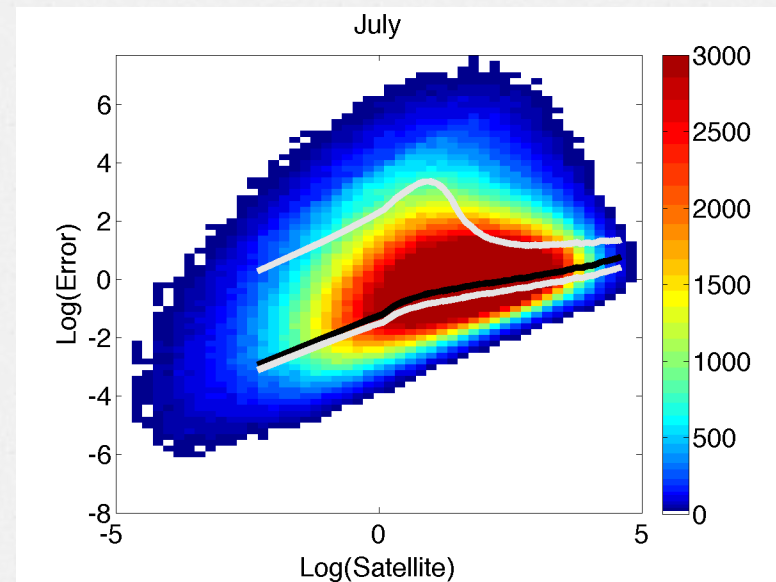
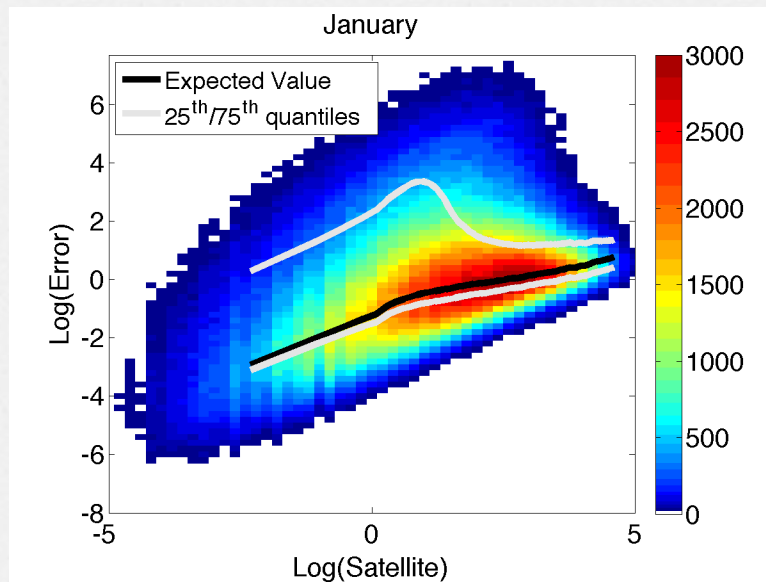
Probability distributions



Normalized differences = (Estimated - Observed)/Observed

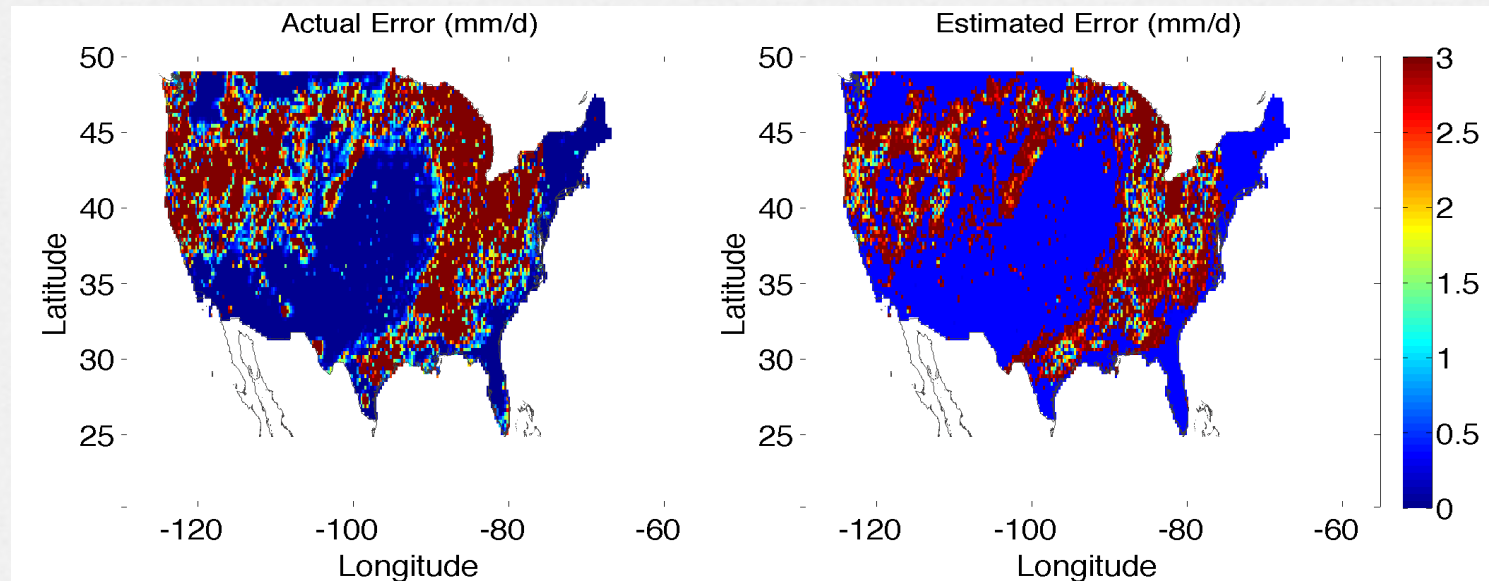


The error estimate



Results over CONUS, using parameters calibrated over OK

Error Maps: 24 October 2004



$$\text{Error } (\epsilon) = |S - R|$$

Concluding Remarks

- Preliminary results are promising as the estimated distributions are shown:
 - to reproduce the probability density functions of the actual rainfall in terms of shape and magnitude
 - to reproduce the error spatial pattern
- Expansions of this work will look at:
 - different satellite rainfall products
 - real-time product (biased)
 - higher time resolutions (i.e., 3-hrs)
- This framework will be parameterized (by surface, convective regime, season etc.) in order to be applicable everywhere.